DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 9/20/2010 has been entered. Claims 1, 10 and 11 were amended.

2. The texts of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action issued on 12/23/08.

Claim Rejections - 35 USC § 103

3. The claim rejections under 35 U.S.C. 103(a) as being unpatentable over Noetzel et al. (US 2003/0235730) and further in view of Fujita et al. (US 2002/0192519 A1) and Keskula et al. (US 2002/0051899 A1) on claims 1, 10 and 11 are withdrawn.

4. Claims 1, 10 and 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Noetzel et al. (US 2003/0235730) in view of Keskula et al. (US 2002/0051899 A1).

Regarding claim 1, Noetzel teaches a power condition 14 (“control device”) which includes power converter circuitry 22, gate drive circuitry 24, control logic 26, and mode controller 28 (paragraph 20) of a vehicular fuel cell system (paragraph 18), wherein mode

controller 28 determines the mode in which power condition 14 and fuel cell unit 12 operate in order to maintain efficient operation and/or increase the efficiency thereof (paragraph 26). Fuel cell 12 has three general modes of operation, i.e., start-up, operating and cool down modes (paragraph 29). During the start-up mode of operation, the fuel cell unit 12 has not reached its intended operational temperature. The difference between the current and voltage of the stack, I_{STACK} and V_{STACK}, respectively, are compared to predetermined current and voltage values, and control logic 26 issues a control signal 50 placing power switching device 42 into start-up mode, substantially an open circuit, in which current from fuel cell to loads is substantially disallowed or precluded (paragraphs 25, 26, 29 and 30). Thus, Noetzel discloses a "warm-up output control section" configured in the manner claimed.

Noetzel discloses that when the fuel cell unit reaches a predetermined start-up or warm-up temperature, the values of current and voltage have reached the predetermined values detected by mode controller 28 of power condition 14 and in response to the actual current and voltage values, I_{STACK} and V_{STACK} respectively, exceeding the predetermined threshold values, issues an updated mode control signal allowing the fuel cell to exit the start-up mode and enter the operating mode (paragraphs 31-32). Thus, Noetzel discloses a "run permission section" configured in the manner claimed in which the fuel cell is selectively connected/disconnected dependent at least in part upon at least one of a fuel cell voltage, current and temperature (paragraphs 10 and 31-32).

Noetzel discloses that the fuel cell enters operating mode ("run permission") when the voltage and current values of the stack exceed predetermined threshold values ("run available current/voltage values") (paragraphs 25-32), but does not disclose the manner in which these

predetermined threshold values ("run available current/voltage values") are obtained. In other words, Noetzel does not teach that the predetermined current/voltage value ("run available current/voltage value") is obtained from predetermined current/voltage characteristics showing a relationship between the electric current/voltage value of the fuel cell stack and the run available voltage/current at a temperature at which an output value of the stack is available to provide the vehicle with run permission as recited in the claim; however, Keskula discloses analogous art of a fuel cell stack monitoring and control system in which the actual current and actual voltage are monitored, the expected voltage as a function of the actual current is determined based on a predetermined relationship between voltage and current from polarization curves, the variance between the two actual voltage and the expected voltage is calculated and a signal is generated and corrective action is indicated (paragraphs 10-17, 27 and 55). Keskula discloses that a fuel cell stack can be characterized by a voltage at a given current or conversely, as a current at a given voltage. This is called a polarization curve and a family of polarization curves is determinable as a function of fuel cell stack operating conditions including temperature (paragraph 27). More simply stated, for a given operating condition or range of operating conditions, it is possible to establish a relatively nominal polarization curve (paragraph 27). Keskula teaches that if the relationship between the actual voltage is outside the variance limits about the curve, a diagnostic/signal is generated (paragraphs 14 and 28). Furthermore, the invention establishes a relationship between voltage and current and other operating variables including stack temperature (paragraph 30).

Thus, Keskula discloses that a diagnostic/signal (i.e., a "run permission signal") may be generated when the voltage/current value of the fuel stack is equal to or more/less than a

predetermined voltage/current value which is determined from a polarization curve characterized by voltage at a given current or current at a given voltage at specific operating conditions such as temperature ("i.e., "at a temperature at which an output value of the stack is available to provide the vehicle with run permission"), and generating a signal/diagnostic based on the variance value of the two values (paragraphs 27, 30 and 55). Keskula teaches that the present control method may be easily implemented in existing fuel cell controllers (paragraph 20) and that it is advantageous to have such an enhanced detection system to detect the situation where the amount of actual power is significantly different from the predicted power for a given load point (paragraph 71). Furthermore, the method allows the diagnostic trip point to be effectively variable as a function of load (paragraph 72) and provides many advantages over existing alternatives which address high and low voltage situations (paragraph 73).

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the control device of Noetzel such that the predetermined voltage and current values ("run available voltage/current values") for the fuel cell stack are determined from polarization curves characterized by voltage at a given current or current at a given voltage at specific operating conditions such as temperature because Keskula discloses such a configuration and teaches that this allows the diagnostic trip point to be effectively variable as a function of load (paragraph 72) and provides many advantages over existing alternatives which address high and low voltage situations (paragraph 73).

Regarding claim 10, the same limitations as claim 1 appear in claim 10 with the exception of means-plus-function language which will be dealt with subsequently; therefore, please see the rejection of claim 1 for the rejection of claim 10. The Applicant's specification

supports the "means… for controlling the fuel cell stack" and the "means... for providing a vehicle with run permission" as recited in claim 10 (see Applicant's specification, page 5, lines 15-30). Accordingly, this means-plus-function language invokes a 35 U.S.C. 112, sixth paragraph limitation (see MPEP 2181). The means "for controlling the fuel cell stack" and the means for "providing a vehicle with run permission" are interpreted to be a control device comprised of a warm-up output control section operative and a run permission section that make determinations on the temperature of the fuel cell on the basis of current and voltage values of the fuel cell.

Regarding claim 11, Noetzel teaches a method of controlling a fuel cell system (abstract) in which a mode controller 28 which is part of power conditioner 14 ("control device") determines the mode in which power condition 14 and fuel cell unit 12 operate in order to maintain efficient operation and/or increase the efficiency thereof (paragraph 26). Fuel cell 12 has three general modes of operation, i.e., start-up, operating and cool down modes (paragraph 29). During the start-up mode of operation, the fuel cell unit 12 has not reached its intended operational temperature. The difference between the current and voltage of the stack, I_{STACK} and V_{STACK}, respectively, are compared to predetermined current and voltage values, and control logic 26 issues a control signal 50 placing power switching device 42 into start-up mode, substantially an open circuit, in which current from fuel cell to loads is substantially disallowed or precluded (paragraphs 25, 26, 29 and 30). Thus, Noetzel discloses drawing a warm-up electric power by controlling a fuel cell 12 to generate power under a start-up mode ("low temperature condition") as recited in the claim.

Noetzel discloses that when the fuel cell unit reaches a predetermined start-up or warm-up temperature, the values of current and voltage have reached the predetermined values detected by mode controller 28 of power condition 14 and in response to the actual current and voltage values, I_{STACK} and V_{STACK} respectively, exceeding the predetermined threshold values, issues an updated mode control signal allowing the fuel cell to exit the start-up mode and enter the operating mode (paragraphs 31-32). Thus, Noetzel discloses a "run permission section" configured in the manner claimed in which the fuel cell is selectively connected/disconnected dependent at least in part upon at least one of a fuel cell voltage, current and temperature (paragraphs 10 and 31-32).

Noetzel discloses that the fuel cell enters operating mode ("run permission") when the voltage and current values of the stack exceed predetermined threshold values ("run available current/voltage values") (paragraphs 25-32), but does not disclose the manner in which these predetermined threshold values ("run available current/voltage values") are obtained. In other words, Noetzel does not teach that the predetermined current/voltage value ("run available current/voltage value") is obtained from predetermined current/voltage characteristics showing a relationship between the electric current/voltage value of the fuel cell stack and the run available voltage/current at a temperature at which an output value of the stack is available to provide the vehicle with run permission as recited in the claim; however, Keskula discloses analogous art of a fuel cell stack monitoring and control system in which the actual current and actual voltage are monitored, the expected voltage as a function of the actual current is determined based on a predetermined relationship between voltage and current from polarization curves, the variance between the two actual voltage and the expected voltage is calculated and a signal is generated

and corrective action is indicated (paragraphs 10-17, 27 and 55). Keskula discloses that a fuel cell stack can be characterized by a voltage at a given current or conversely, as a current at a given voltage. This is called a polarization curve and a family of polarization curves is determinable as a function of fuel cell stack operating conditions including temperature (paragraph 27). More simply stated, for a given operating condition or range of operating conditions, it is possible to establish a relatively nominal polarization curve (paragraph 27). Keskula teaches that if the relationship between the actual voltage is outside the variance limits about the curve, a diagnostic/signal is generated (paragraphs 14 and 28). Furthermore, the invention establishes a relationship between voltage and current and other operating variables including stack temperature (paragraph 30).

Thus, Keskula discloses that a diagnostic/signal (i.e., a "run permission signal") may be generated when the voltage/current value of the fuel stack is equal to or more/less than a predetermined voltage/current value which is determined from a polarization curve characterized by voltage at a given current or current at a given voltage at specific operating conditions such as temperature ("i.e., "at a temperature at which an output value of the stack is available to provide the vehicle with run permission"), and generating a signal/diagnostic based on the variance value of the two values (paragraphs 27, 30 and 55). Keskula teaches that the present control method may be easily implemented in existing fuel cell controllers (paragraph 20) and that it is advantageous to have such an enhanced detection system to detect the situation where the amount of actual power is significantly different from the predicted power for a given load point (paragraph 71). Furthermore, the method allows the diagnostic trip point to be effectively

variable as a function of load (paragraph 72) and provides many advantages over existing alternatives which address high and low voltage situations (paragraph 73).

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the control device of Noetzel such that the predetermined voltage and current values ("run available voltage/current values") for the fuel cell stack are determined from polarization curves characterized by voltage at a given current or current at a given voltage at specific operating conditions such as temperature because Keskula discloses such a configuration and teaches that this allows the diagnostic trip point to be effectively variable as a function of load (paragraph 72) and provides many advantages over existing alternatives which address high and low voltage situations (paragraph 73).

5. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Noetzel et al. (US 2003/0235730) in view of Keskula et al. (US 2002/0051899 A1) as applied to claims 1, 10 and 11 above, and further in view of Ito (Japanese Patent 2002-134150A).

Regarding claim 6, Noetzel teaches the run permission section (power switching device 42) providing the vehicle with run permission when the temperature of the fuel cell stack is equal to or more than a predetermined value (paragraph 10); however, Noetzel does not teach that the vehicle is provided with run permission based specifically on the temperature of the coolant in the fuel cell stack as recited in the claim. Ito provides analogous art of a fuel cell system in which a standby-detection means detects standby of the fuel cell based on the output voltage of the fuel cell (paragraph 8). Ito further discloses that the standby detection means detects standby based on the temperature of the cooling water ("coolant") which is supplied to the fuel cell (paragraph 9). Ito teaches that the standby detection means promotes warming up by generation

of heat of a fuel cell and that by placing the fuel cell on standby based on the cooling water ("coolant") flowing through the fuel cell, the standby of the fuel cell can be recognized correctly and the fuel cell can be heated according to a warm-up situation which is promptly given thus raising the efficiency of the fuel cell (paragraph 16).

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the invention of Noetzel to include monitoring the temperature of the coolant in the stack in order to determine run permission for a vehicle because Ito discloses analogous art in which both the voltage and coolant temperature of a stack are monitored in order to determine standby (i.e., warm-up) operation or normal operating parameters and that this allows the standby condition to be recognized correctly and the fuel cell can be heated according to a warm-up situation which is promptly given thus raising the efficiency of the fuel cell (paragraph 16).

6. Claims 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Noetzel et al. (US 2003/0235730) in view of Keskula et al. (US 2002/0051899 A1) as applied to claims 1, 10 and 11 above, and further in view of Matoba (U.S. 2004/0005487) and Condit (US 2003/0039873).

Regarding claim 7, Noetzel teaches a fuel cell system including a "run permission section," but fails to teach that when the temperature of coolant in the fuel cell stack is less than a predetermined value, an auxiliary device is provided to a power plant including the fuel cell stack in order to heat the fuel cell stack. Matoba discloses analogous art of a fuel cell system provided with technology for preventing damage to the system caused by low temperature environments (paragraph 1). Matoba discloses that when the temperature of a fuel cell 17 falls

below a predetermined temperature, a controller switches the change-over valve 39 such that the temperature of the coolant is raised in the heat exchanger 10 (paragraph 27). Matoba discloses that the heat exchanger 10 is supplied with combustion gas from combustor 9 (“auxiliary device”) and is used as a heat source (paragraph 25) in the coolant passage 15 which circulates through the fuel cell so as to adjust the temperature of the fuel cell by adjusting the temperature of the coolant (paragraph 28).

Therefore, it would have been obvious to one of ordinary skill in the art to modify the system of Noetzel such that when the temperature of the stack falls below a predetermined value, the controller controls a combustor ("auxiliary device") to heat the coolant circulating therethrough in order to adjust the temperature of the coolant and stack because Matoba discloses such a configuration and notes that this allows for damage to the system to be prevented caused by low temperature environments (paragraph 1).

Furthermore regarding claim 7, Matoba notes that when the temperature of the stack falls below a predetermined temperature, the controller activates a valve in order to raise the temperature of the coolant; however, Matoba does not recite that the temperature detected is specifically the fuel cell coolant temperature. Condit discloses analogous art of a fuel cell power plant in which a controller actuates valves to heat the fuel cell 12, coolant loop 48 and accumulator whenever the controller senses a temperature of the fuel cell, coolant loop 48 or accumulator 78 descending below a minimum temperature (paragraphs 33 and 35). Thus, Condit discloses that detection of the temperature of the fuel cell or detection of the temperature of the fuel cell stack coolant are considered functional equivalent temperature determinants of power plant operating in a low temperature environment (paragraph 33).

Therefore, it would have been obvious to a person of ordinary skill in the art to substitute detection of the temperature of the coolant flowing through the fuel cell stack as taught by Condit for the detection of the temperature of the stack as taught by Matoba because Condit discloses that these are functionally equivalent ways to determine a low temperature condition (paragraph 33).

Regarding claim 8, Matoba teaches that the “auxiliary device” is a combustor 9 to which effluent emitted from the fuel cell stack 17 is introduced (paragraph 25).

7. Claims 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Noetzel et al. (US 2003/0235730) in view of Keskula et al. (US 2002/0051899 A1) as applied to claims 1, 10 and 11 above, and further in view of Condit et al. (US 2003/0039873).

Regarding claim 7, Noetzel teaches a fuel cell system including a “run permission section,” but fails to teach that when the temperature of coolant in the fuel cell stack is less than a predetermined value, an auxiliary device is provided to a power plant including the fuel cell stack in order to heat the fuel cell stack. Condit discloses analogous art of a fuel cell power plant in which a controller actuates valves to heat the fuel cell 12, coolant loop 48 and accumulator whenever the controller senses a temperature of the fuel cell, coolant loop 48 or accumulator 78 descending below a minimum temperature (paragraphs 33 and 35). The controller senses a temperature of the fuel cell 12, coolant loop 48 or accumulator 78 descending below the minimum temperature, the controller activates the heater 94 ("auxiliary device”) so as to warm coolant in order to heat the fuel cell (paragraph 33).

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the system of Noetzel to include a heater ("auxiliary device") that provides heat the fuel cell system so as to heat the fuel cell stack when the stack is less than a predetermined value because Condit discloses such a system and notes that this allows no mechanical damage to occur to the plant from freezing/low temperatures (paragraph 33).

8. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Noetzel in view of Keskula et al. (US 2002/0051899 A1), Matoba (U.S. 2004/0005487) and Condit (US 2003/0039873) as applied to claims 7 and 8 above, and further in view of Beutel et al. (U.S. 2003/0134239 A1).

Regarding claim 9, Matoba teaches a combustor 9 combusting the effluent of the fuel cell and a heat exchanger 10 allowing combustion heat of the exhaust to be transferred to the coolant as is illustrated in Figure 1 (paragraphs 25-29), but fails to teach that the combustor is provided with an electric-heated catalyst section. Beutel discloses analogous art of a fuel cell system having a combustor in which the catalytic combustor is provided with an electrically-powered heating element in order to reduce the start-up time to heat the catalyst (paragraph 6).

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the combustor of Matoba to have an electrically-powered heating element because Beutel discloses that this allows for the reduction of the start-up time to heat the catalyst in a combustor (paragraph 6).

Response to Arguments

9. Applicant's arguments filed 9/20/2010 have been fully considered but they are not persuasive.

Applicant's remaining principal arguments are

(a) Neither Noetzel nor Keskula disclose that the run available current or voltage value are obtained from a predetermined current/voltage characteristics showing a relationship between a current or voltage value of the fuel cell stack and the run available voltage or current at a temperature at which the output value of the fuel cell stack is available to provide the vehicle with the run permission.

In response to Applicant's arguments, please consider the following comments.

(a) Keskula discloses a fuel cell stack monitoring and control system in which the actual current and actual voltage are monitored, the expected voltage as a function of the actual current is determined based on a predetermined relationship between voltage and current from polarization curves, the variance between the two actual voltage and the expected voltage is calculated and a signal is generated and corrective action is indicated (paragraphs 10-17, 27 and 55). Keskula discloses that a fuel cell stack can be characterized by a voltage at a given current or conversely, as a current at a given voltage. This is called a polarization curve and a family of polarization curves is determinable *as a function of fuel cell stack operating conditions including temperature* (paragraphs 27 and 30).

A diagnostic/signal (i.e., a "run permission signal") may be generated when the voltage/current value of the fuel stack is equal to or more/less than a predetermined voltage/current value which is determined from a polarization curve characterized by voltage at a given current or current at a given voltage at *specific operating conditions such as temperature* (“i.e., “at a temperature at which an output value of the stack is available to provide the vehicle with run permission”), and generating a signal/diagnostic based on the variance value of the two values (paragraphs 27, 30 and 55).

Thus, Keskula discloses that the invention establishes a relationship between voltage and current as modified by other operating variables, for example, stack temperature (paragraph 30). The variance from the relationship is calculated based on the monitored temperature (paragraph 30). Therefore, the polarization curve used is dictated by the temperature of the stack, thus, Keskula reads on the newly added claim limitation of obtaining current/voltage characteristics at a specific temperature, such as the temperature at which the output value of stack can provide the vehicle with run permission.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AMANDA BARROW whose telephone number is (571)270-7867. The examiner can normally be reached on 7:30am-5pm EST. Monday-Friday, alternate Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ula Ruddock can be reached on 571-272-1481. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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